



## Exploring the Second Language Mental Lexicon With Word Association Tests

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### Abstract

Based on the theory of spreading activation model and word association test, the paper probes into the semantic structure of the L2 mental lexicon. A carefully designed word association test was conducted among 150 sophomores majoring in intensive English from Dalian University of Technology. This study investigates paradigmatic relation, syntagmatic relation and phonological relation produced by different subjects to different stimulus words. Compared with the association test taken by native English speakers, the following are main findings: (a) The semantic connections between the L2 mental lexicon are fewer than those between the L1 mental lexicon. (b) In the semantic structure of the L2 mental lexicon, paradigmatic link wins a predominant percentage over syntagmatic link. (c) The L2 learners produces phonological responses or null responses more than meaningful responses when coming across unfamiliar lexicon. Based on these findings, this paper suggests in the L2 learning, it is important to build the semantic structure of mental lexicon on the basis of experiential knowledge.

**Key words:** L2 mental lexicon; Word association test; Spreading activation model

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### INTRODUCTION

Vocabulary plays a significant role in language learning and teaching, which is also in the dominant position in learning a second language. According to Wilkins (1972), "Without grammar, little can be conveyed; without vocabulary, nothing can be conveyed." As a result of its great importance in language learning, the past decades have witnessed the growing concerns of lexical acquisition and teaching. However, compared to what has been done in the field of vocabulary, grammar, phonology, and discourse studies, much less is known about the nature of L2 learners' lexicon (Coady & Huckin, 1997). However, in recent years, there have been many studies on mental lexicon, which is a relatively new area of research in psycholinguistics. The concept of mental lexicon was first introduced by Treisman (1960). Mental lexicon research shows how words in the mind are acquired, organized and how our lexical knowledge is processed. Nowadays much progress has been made on researches of L1 mental lexicon. According to those findings, some scholars assume the storage and way of functioning of L2 mental lexicon are probably like that of L1 mental lexicon. Indeed, to some extent, L2 and L1 lexical development do parallel each other. But studies show that the real situation is that there are great differences between the L1 and the L2 learners.

Recently, the question of the respective roles of form and meaning in the acquisition and processing of L2 lexis has been a prominent theme of recent debate. There are three main attitudes towards the nature of the L2 mental lexicon. One claim has been that the basis of the operations of the L2 lexicon is phonological rather than semantic, because L2 learners tend to produce a large amount of clang responses in the test; one is on the contrary; the other claims that the grammatical arrangement of words, that is the syntagmatic link, plays a significant role in the L2 mental lexicon.

Nowadays, researchers well agree that words in the mental lexicon are linked together in the semantic structure. There are four models in the semantic structure of mental lexicon, namely, the semantic network, hierarchical network model, the prototype theory and the spreading activation theory. Among these models, those based on the semantic network are considered the most reasonable. The most popular network models in cognitive psychology and psycholinguistics are the spreading activation models. The spreading activation model was first introduced by Collins and Loftus (1975, cited in Liu, 2000). This model suggests that the mental lexicon is organized as a network of interconnected elements (concepts or nodes), and that the distance between different nodes is determined by structural property and functional factors. A feature is not necessarily connected with only one word but may be shared by words at different nodes. Thus the retrieval of information becomes a spread of activation, that is to say, when one node is activated, the activation may spread along the associative pathway in different directions and even to the entire network.

Among all the research methods into the mental lexicon, word association test is widely employed. In a word association test, a stimulus word is given to the subjects and the subjects are required to respond with the first words coming to mind. Often the tests can be categorized into two types: free association and controlled association. In researches concerning word association tests, people usually use words from Kent-Rosanoff Word Association Test as the stimulus words.

The objective of this study is to compare the semantic structure of the L1 and L2 mental lexicon in different languages through word association tests according to the spreading activation model. It aims at explaining how the words are organized and extracted in the mind, the results of which can be directly applied in the lexical teaching, especially in the L2 lexical learning and how to improve the efficiency of studying foreign languages.

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## 1. METHODOLOGY

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The present study tries to explore the semantic structure of the L2 mental lexicon on the basis of spreading activation model. It aims at investigating the nature of second language mental lexicon with word association tests. The words stored in the mental lexicon are organized mainly in two networks: semantic and phonological. In semantic network, words from the same semantic field are closely related, while in phonological network, words with similar sounds are tightly connected. And the question is whether the L2 mental lexicon is organized and processed in the same way as the L1 mental lexicon or in a different way. If the semantic structure of the L1 and L2 mental lexicon is

different, what are the differences? Furthermore, how can we apply what we have found out in the lexical teaching?

### 1.1 Research Design

#### 1.1.1 Subjects

150 sophomores of English major of Dalian University of Technology were asked to take the word association test. All of them are native speakers of Chinese with English as their second language. None of them has ever lived in an English environment. Among the 150 students, 21 students produced more than 6 zero response in the association test, so their test papers were regarded as being invalid. Thus the actual number of subjects for this study is 129.

#### 1.1.2 Stimuli and the Type of Word-Association Test

Choosing the stimuli or stimulus words can be helpful to maintain the reliability of the study. Great consideration should be taken when selecting the stimuli. On the one hand, nouns, verbs, and adjectives should be selected as the kind of investigation words in order to meet the need of the present study and also to reduce the inadequacies of the single class of words, as a lot of researchers have agreed. On the other hand, Bai (2005) found out in his word association study that if the L2 learners are not familiar with these stimulus words, there will be no semantic network in their mental lexicon and that words of low frequency include zero or almost no word association in their mind. Thus the stimuli chosen for this paper should be known well by the subjects.

The type of word-association test chosen for this study was the “continuous association” approach, which encourages subjects to produce as many associates as possible per stimulus word within a given time-span (Randall, 1980). According to Meara, this method has the advantage that ‘stable response patterns can be found with as few as 15 subjects’ (Meara, 1980), whereas the standard single-response test is deemed to yield stable results only when rather large numbers of subjects are involved (Deese, 1965).

Based on all the considerations, the researcher selected 50 English stimuli taken from the Kent-Rosanoff (1910; Postman & Keppel, 1970) inventory of 100 frequently occurring, emotionally neutral English words. There were 29 nouns, 18 adjectives, and 3 verbs. They were: table, dark, music, sickness, man, deep, soft, eating, mountain, house, black, mutton, comfort, hand, short, fruit, butterfly, smooth, command, chair, sweet, whistle, woman, cold, slow, wish, river, white, beautiful, window, rough, citizen, foot, spider, needle, red, sleep, anger, carpet, girl, high, working, sour, earth, trouble, soldier, cabbage, hard, eagle and stomach. It should be noted that some words belonged to two word classes (usually verbs and nouns), but students tended to favor one class while neglect the other. All together, there are 50 prompt words in this test.

### 1.1.3 Design of the Slide Show and Answer Books

In this word association test, a PowerPoint was used to make a list of the stimulus words. There were 50 pages in this PPT, each page containing one word. The slide would turn to another page in 30 seconds automatically. In order to avoid any pattern recognition on the part of the subjects with respect to word class or frequency, the prompt words were presented in a random order. Also, answer books were provided for each test. In the answer books, there were several blanks for subjects to fill in about their personal information, including grade, major, gender, birth year and the score of the exams taken. Besides that, specific guidelines on how to proceed the test were given too. Such guidelines were all written in Chinese. The answer book also comprised one sheet of blank lines numbered 1-50. The stimulus words did not appear in the answer books but were presented visually using a slide projector.

### 1.2 Procedures

The test was conducted in a classroom in the normal class hours in three different classes. At the beginning, answer books were handed out to subjects and they were asked to write down their personal information in the blanks. Then several minutes were given to them to finish reading the instructions on the answer sheet. The researcher then explained the guidelines in Chinese and answered the questions from subjects if they had problem of understanding the procedures. In addition, the students were not told about the nature of the study so as to reduce the “practice effect”. Then the test began and the slide started to project. When the slide jumped to the next page, the researcher would say “next one” in order to remind the subjects that 30 seconds were up and they should start to do the next word’s association. During the test, they were not allowed to consult any dictionaries, nor were they allowed to discuss with each other. Every test lasted about 35 minutes.

### 1.3 Data Collection

As mentioned above, the data were collected using answer books. Before every test, the researcher sent the answer books to the subjects, and got them back when the test finished. Then the responses of the students were classified for further analysis.

Step one: Check the answer books and keeping the invalid ones out. Some students failed to produce responses to more than six stimulus words. As a result, their questionnaires should be considered to be invalid. Also, some students failed to provide their personal information correctly, so their responses could not be collected as data. At last, 129 valid answer sheets were left.

Step two: Since there were a large number of responses, the researcher put them in the form of different sheets in an Excel document. One answer book from one subject covered one sheet. Then computer was used to count up the number of the repeated words and do the comparison.

Step three: Classify the types of data and count the percentage of each type.

## 2. RESULTS ANALYSES

### 2.1 Comparison Between L2 Learners’ and Natives’ Responses

For the convenience of presentation and discussion, nine words were singled out randomly using the Microsoft Excel tools, three from each word class. After the number of the same English responses in this paper was counted and arranged in a sequence from the most to the least, the first four or five responses were singled out and their counterparts were also counted and listed together (Table 1) for discussion, with the exact number following each response.

**Table 1**  
**Comparison Between L2 Learners’ and Natives’ Responses**

Words	L2 learners’ responses	Natives’ responses
Table	chair 65, desk 64, food 15, wood 15, cup, 14	chair 174, cloth 4, top 3, mat 3, leg 2, wall 2, food 2, desk 2
Music	song 43, musician 26, sing 20, singer 18, instrument 16, piano 14	Piano 47, notes 22, sound 17, songs 16, orchestra 7
Man	woman 97, girl 36, boy 24, human 21, child 17	woman 154, boy 6, hat 4, child 4, clothes 2, car 2, wife 2
Dark	light 44, black 38, night 35, sun 30, moon 28	light 140, night 20, room 11, black 11, cat 2, bright 2, white 2
Short	long 85, tall 24, high 14, small 10, hair 8	tall 75, long 55, fat 18, man 6, person, 4
Words	L2 learners’ responses	Natives’ responses
Cold	hot 46, warm 34, winter 30, snow 25, cool 17	hot 77, warm 17, ice 13, winter 11, snow 9
Command	commander 33, order 29, war 12, general 10, soldier 10	order 74, obey 33, soldier 11, army 9, teacher 6
Sleep	bed 41, dream 31, night 22, sleepy 15, wake 14, nightmare 10	bed 62, wake 31, rest 14, pillow 12, dream 10
Wish	hope 76, dream 24, future 9, birthday 6, desire 6	want (ing) 32, hope 20, think (ing) 19, desire 18, well 13

Judging from the table, the L2 learners and natives' responses to the same English stimuli are not very much similar in different word class, and their respective percentage to the total responses is quite different too. Of the nine words, only English responses to the stimulus 'cold' could find almost all their equivalents in its counterpart's column. Taking the responses to the rest stimulus word into consideration, we can see that they are not equally matched. For example, the most frequent response to 'music' by the L2 learners is 'song', while 'piano' is the most frequent word the native speakers associate with. In the L2 learners' column, 'piano' ranks the sixth while in natives column, 'song' ranks the fourth.

## 2.2 An Overview of the Association Types

An overview about the different percentages of the four types of responses will be presented (Table 2) to see the general pattern of subjects' association. For clarity and comparison, the results will be presented in the sequence of paradigmatic relation, syntagmatic relation, clang responses and null responses. For convenience of presentation and discussion, we still use the nine words listed above since the total number of responses to 50 stimulus words given by 129 subjects are too many to present here.

**Table 2**  
**Percentages of Four Types of Responses**

Relations	Number of responses	Percentage
Paradigmatic	4,279	85%
Syntagmatic	503	10%
Clang	201	4%
Relations	Number of responses	Percentage
Null response	51	1%
Total	5,034	1

As can be seen from the table, the most responses subjects presented are of paradigmatic relations to the stimuli, the proportion of which is 85%. The second type of responses subjects produced is of syntagmatic nature, the percentage being 10%. Clang responses are not so significant in subjects' responses, which occupy 4% of the total. The paradigmatic and syntagmatic relations produced by the subjects predominantly outweigh those clang or null responses.

As a matter of fact, the familiarity of the stimulus words is also an important factor affecting the organization of the L2 learners' mental lexicon. To those unfamiliar words the L2 learners produced the highest proportion of clang or other responses, while to the familiar ones the L2 learners produced the highest proportion of paradigmatic responses. For example, during the association test, many of the subjects got confused when they came across the

word 'mutton'. They had to guess its meaning and wrote down the associations. Moreover, some of them produced null responses.

## 3. DISCUSSION

### 3.1 Connections Between Words in the L2 Mental Lexicon

Psycholinguists generally agree that words in the mental lexicon are stored in a semantic network, though their opinions may differ on whether it is a hierarchical network or not. A language user knows a large number of words related to one another in a great number of ways. The findings of the present research firmly support that these relations are mainly semantic with a few other forms of relations.

From a communicative point of view, semantic relations are more desirable. However, during the association test, the researcher heard some of the subjects murmuring in Chinese. As a result, for L2 learners, there may be another kind of sense relation: L2-L1 translation equivalent. While in the L2-L1 translation, the phonological connections are less preferred, because communication is carried out to convey meaning, but through phonological connections only similar forms are activated.

### 3.2 Reorganization of the Semantic Network in the L2 Mental Lexicon

Judging from the comparison between L2 learners and natives' responses discussed in Chapter 4, we may see a lack of tight semantic connections between words in the L2 mental lexicon compared with the L1 mental lexicon. Welsh (1988) and Meara (1992) found that the L2 mental lexicon was less dense than the L1 mental lexicon. That is to say, there were far fewer semantic connections between words in the L2 mental lexicon than those in the L1 mental lexicon (Zhang, 2003). As a result, we may suggest that semantic network building can help students familiarize with the words, in other words, strengthen the link between the words in second languages and the conceptual representation. Singleton (1999) held that the same view that semantic integration was the more challenging component of the acquisition of any word in any language. Then the next question is how to build the semantic network.

This study suggests that the semantic network building for the L2 mental lexicon should be based on L2 learners' experiential knowledge in that words linked through learners' experiential knowledge are prone to be associated together. Thus teaching the second language in authentic or quasi-authentic environment is preferred. Words taught in this way will more easily come to people's mind and become a source for recognition of that word because people's encounter with the word has

become part of their experiential knowledge. The concept of situational approach to language teaching has long been advocated. Coady and Huckin (1997) held that new vocabulary should neither be presented in isolation nor learnt in rote fashion, but rather they should be presented in a meaningful context. Singleton (1999) suggested that L2 words were more likely to be retained when mental effort was expended in relating the items to surrounding materials as well as the already existing knowledge. Nunan (1991) thought that people tended to more readily learn the relevant, interesting and useful information than other kind. Of course, this way of teaching is quite demanding and in some cases hard to operate. Then trying to relate the word to children's daily activities or things they are familiar with also work for semantic network building.

Besides, the word association test also demonstrates that sentences or phrases are usually involved in the process. Examples as such are *mountain-climb* in "climb a mountain", *sleep-bed* in "sleep in bed", and *fruit-eat* in "eat the fruit". So asking learners to make phrases or sentences using the newly learnt words is also a good way to strengthen the links between the L2 lexicon.

### 3.3 Application of Spreading Activation Model in the L2 Lexical Teaching and Learning

Based on the spreading activation model, the mental lexicon is organized as a network of interconnected elements, consisting of concepts or nodes connected to one another. According to the theory, long-term memory contains interconnected units of information. These connections produce associations between the units (you think of one, you automatically think of the other) or pathways that control how you retrieve information (you must travel along the connecting lines). Collins and Loftus (1975) said that the connections were based on personal experience and were not necessarily logical. Additional features of the spreading activation model are as follows. First, concepts and properties are treated equally in the sense that each can be accessed directly. Second, not only are properties linked to concepts, but also to other properties. For example, "can fly" could be linked directly to "can sing". Third, links between units of information vary in length. The longer the line between two units, the weaker is the degree of association between them. Advantages of the model are that it can explain the familiarity effect, the typicality effect, and direct concept-property associations, whose biggest advantage is that it explains "priming" as that you are more likely to retrieve information from memory if related information has been presented a short time before. The spreading activation model offers a more flexible way to store and retrieve the words, explaining the characteristics of the mental lexicon. This theory can be applied to improve the efficiency of lexical learning.

The words are stored in students' minds in a dynamic

state. The core of this state is the words kept firmly in mind. Outside the core, are those words not so strong in the memory, which the students can recognize but cannot recall. Words displayed further from the core are those can be recognized in certain specific circumstances. Then the words which are the easiest to forget lie in the furthest from the core. Some lexicon can change their position from the exterior to the interior as a result of the organization, while some lexicon can be forgotten if they are not processed for a long time. Moreover, the level of activation differs according to the words' position, and words that are nearer the core, are easier to be activated. The study suggests that the teachers should be aware of this dynamic system when setting the goal of lexical learning and testing it. Teachers can establish an aim suiting the students' real level of lexical knowledge.

Meanwhile, the words don't exist in memory alone but are connected by nodes which represent the lexical knowledge through kinds of relations. The lexicon can form a complicated but systematic network. In this system, words are related to each other; however, there are differences among relations of words. Based on this network theory, we can find the newly learnt words have to find their own positions if they are to be stored in long-term memory. Once the new lexicon has found its proper seat in the network and enter it successfully, it can build different relations with its neighboring words. Then it can be stored in this network as a member of this system. This indicates us that in lexical learning, we can classify the words in a certain way to build relations with other words through comparison or association.

Also, the spreading activation model can play an important role in reviewing words. Like all the other mental activities concerning memory, forgetfulness is the biggest enemy in lexical learning. The process of memorization is the process of struggling with oblivion. Since information in mind is easier to be retrieved with a more intensified memory, teachers have to be aware of strengthen the intensity of the mental lexicon. This fully explains the importance of efficient review in L2 teaching. An organized and efficient review includes: first, review the words in great number in order to activate the words' neighboring related lexicon. Second, add the conceptual, syntactic, phonological knowledge to the storage of the lexicon so as to build closer ties with the core. As long as the core is activated, the lexicon near it is easier to be activated and then more words can be retrieved. In this way, we can improve the efficiency of words review. Third, we can avoid single way of activation but combine semantic, phonological, syntactic way together to extend the area of activation.

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## CONCLUSION

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The present paper attempts to probe into the semantic relation within the L2 mental lexicon via word association test and thus to provide possible insight into the learning

and teaching of vocabulary of the second language. Though the complicated and dynamic nature of mental lexicon makes it difficult to abstract common features, data collected in word association test may give us some information about the mechanism of L2 mental lexicon. Here are the major findings of this research.

First, as a whole, the L2 learners produced a higher proportion of meaningful responses, including paradigmatic and syntagmatic responses, and a lower proportion of clang-other responses. This indicates that in the L2 mental lexicon, meaning plays a predominant role.

Second, though the result indicates that the lexical connections in the L2 mental lexicon are semantically related, differences between the L2 learners' responses and natives' responses indicates that the L2 learners have not built up semantically meaningful connections quite tightly.

Third, the familiarity of the stimulus words is also an important factor affecting the organization of the L2 learners' mental lexicon. To those unfamiliar words the L2 learners produced more clang-other responses, while to the familiar ones the L2 learners produced many paradigmatic responses.

Although the present study has revealed, to some extent, the organization patterns of the L2 mental lexicon, it still has many limitations. What follows is a summary of these limitations, followed by suggestions for future researchers to overcome them.

In this study, the stimulus words were chosen from Kent-Rosanoff inventory of 100 frequently occurring, emotionally neutral English words. The reason for leaving out low-frequency words is that they may not elicit the responses needed to reveal the organization of the L2 mental lexicon. However, the investigation of individual words of both high and low frequency is suggested for future research, which will become more convincing to make generalization about the structure of the L2 mental lexicon.

Traditionally, there are two approaches to the investigation of the L2 mental lexicon, namely, a cross-sectional approach and longitudinal approach. The present study has adopted a cross-sectional approach. The merit of this approach is that it is time-saving and efficient. There is a consensus that this approach provides a shortcut to the research into the development of the L2 mental lexicon over time. Nevertheless, it has its shortcomings. For the cross-sectional approach, its demerit is reflected in the fact that it does not look into the development of

mental lexicon of the same group of subjects over time, thus failing to reflect the development process in a strict sense. The organization of the L2 mental lexicon possibly changes with the development of the subjects' language proficiency. So it will be better if the future research of its kind could consider adopting longitudinal approach.

With all these problems solved, we will surely have a better idea about the mental lexicon in general and the L2 mental lexicon in particular.

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